

EXHIBIT A

In the matter of

Don Quarles

v.

United States of America, ex rel. Bureau of Indian Affairs;
United States of America, ex rel. Environmental Protection Agency;
Texaco Inc.;
Getty Oil Co.;
Phillips Petroleum Company;
Sun Oil Co.;
Little River Energy Co.;
Yarhola Production Co.;
Spess Oil Company, Inc.;
Chambers & Hendrix Oil and Gas, Inc.; and,
John Does 1-1000, Defendant.

Case No. 00-CV-913-E(J)

in the United States District Court
for the Northern District of Oklahoma

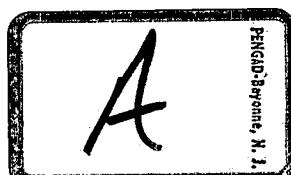
Expert Opinions

of

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222 South Kenosha Avenue
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May 30, 2006

Prepared for

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I. Introduction

I have been retained on behalf of Don Quarles ("Quarles") to provide an expert opinion regarding historic and ongoing pollution of soils, groundwater and surface water on his properties within Osage County, Oklahoma. My opinion is based on the facts set forth below, the documents I reviewed, my training, my general work experience, and my specific work experience in the analysis of methods, techniques, processes and operations used in the exploration for and production of oil and natural gas ("petroleum").

I have worked professionally as a research scientist on matters related to petroleum exploration and production and other aspects of the petroleum industry for nearly twenty-five years, and have worked on technical environmental matters related to wastes generated by the petroleum and other industries, including the petroleum exploration and production industry for nearly thirty years. My experience in technical environmental matters includes site investigations, review of site investigation data, analysis of the chemical and physical characteristics of environmental samples, historic research on petroleum, including exploration and production, wastes the environmental chemistry of organic and inorganic contaminants and studies of the fate and transport of organic and inorganic contaminants in soils, sediments and water.

I hold a Ph.D. and M.S. in Earth Sciences from Case Western Reserve University and a B.S. in Geology and Geophysics from Yale University. I am a Certified Professional Geologist, a Registered Professional Geoscientist in the State of Texas and a Registered Professional Geologist in the State of Mississippi. I have published scientific papers regarding technical environmental matters in peer-reviewed publications, and I have given numerous technical presentations regarding environmental matters at scientific meetings. I have worked on the engineering and scientific aspects of numerous litigation, regulatory and transaction matters, including, specifically, environmental matters related to petroleum exploration and production.

Data and other information I have reviewed in forming my opinion are listed in Section IV. A more detailed recitation of my qualifications and publications is attached to this report as Section V. A list of my expert testimony given in the last four years is given in Section VI. My billing rate for work on this matter is given in Section VII. Specific Exhibits referred to in this report are attached following Section VIII.

II. Bases of Opinions

Quarles owns two properties in Osage County, Oklahoma that are the subject of this lawsuit. These properties are described herein as the eastern property (Exhibit "A") and the western property (Exhibit "B").

The current oil and gas lessee on the eastern property is Spess Oil Company. Prior operators on the eastern property are Little River Energy Co., Link Oil and Yarhola Production Company.

Documents obtained by Conoco-Phillips from the Bureau of Indian Affairs demonstrate that historic oil and gas operations on the eastern property (i.e. drilling, completion, construction and/or operation of oil and gas wells, service wells, surface equipment, gathering systems, tank batteries, and/or pipelines) were conducted by Continental Oil Company, which, through various business transactions, became part of Conoco-Phillips.

Historic oil and gas operations on the western property (i.e. drilling, completion, construction and/or operation of oil and gas wells, service wells, surface equipment, gathering systems, tank batteries, and/or pipelines) were conducted by Skelly Oil, Riverland, Continental Oil, Mutual, Osage Natural Gas, Producers, Gilliland, Peters, Allkay Oil, Wichita Oil, and numerous entities with single well operations.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, a total of 90 petroleum wells exists on the eastern property of Quarles.

Based on direct observation, some petroleum wells located on the eastern property of Quarles are still actively producing petroleum.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, the petroleum wells on the eastern property of Quarles were drilled completed or first produced between 1914 and 1988.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, a total of 28 petroleum wells exists on the eastern property of Quarles that have a date of plugging.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, a total of 62 petroleum wells exists on the eastern property of Quarles that do not have a date of plugging.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, a total of 35 petroleum wells exists on the eastern property of Quarles drilled completed or first produced prior to 1927.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, a total of 12 petroleum wells exists on the eastern property of Quarles drilled completed or first produced prior to 1927 that were plugged prior to 1927.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, there a total of 6 petroleum wells exists on the eastern property of Quarles drilled completed or first produced prior to 1927 that were plugged after to 1926.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, a total of 17 petroleum wells exists on the eastern property of Quarles drilled completed or first produced prior to 1927 that have no listed plugging date.

Documents obtained by Conoco-Phillips from the Bureau of Indian Affairs demonstrate the presence of mud-plugged wells on the Quarles' eastern property.¹

The current oil and gas lessee on the western property is Tony Oil Co.

Historic oil and gas operations on the western property (i.e. drilling, completion, construction and/or operation of oil and gas wells, service wells, surface equipment, gathering systems, tank batteries, and/or pipelines) were conducted by Sunray (DX), Nadel & Gussman, Shamrock, Tomahawk, Wright Oil, Golden Oil and Peters.

¹ Continental Oil Company Well No. 1, SE-2-22N-10E (plugging completed (with mud alone) 10/16/1924); Continental Oil Company Well No. 2, SE-2-22N-10E (plugging completed (with mud alone) 10/30/1934); Continental Oil Company Well No. 3, SE-2-22N-10E (plugged back to 1080' with cement and mud for saltwater receiver 09/02/1929, then plugging completed (with mud alone) on 09/25/1929); Continental Oil Company Well No. 5, SE-2-22N-10E (plugging completed (with mud alone) 11/02/1925).

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, a total of 22 petroleum wells exist on the western property of Quarles.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, the petroleum wells on the western property of Quarles were drilled completed or first produced between 1920 and 1981.

Based on direct observation, some petroleum wells located on the western property of Quarles are still actively producing petroleum.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, a total of 10 petroleum wells exists on the western property of Quarles that have a date of plugging.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, a total of 12 petroleum wells exists on the western property of Quarles that do not have a date of plugging.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, a total of 2 petroleum wells exists on the western property of Quarles drilled completed or first produced prior to 1927.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, a total of 2 petroleum wells exists on the western property of Quarles drilled completed or first produced prior to 1927 that were plugged prior to 1927.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, no petroleum wells exist on the western property of Quarles drilled completed or first produced prior to 1927 that were plugged after to 1926.

Based on review of a database of petroleum-related wells in Osage Country, Oklahoma provided by the Osage Nation Environmental & Natural Resources Department, no petroleum wells exist on the western property of Quarles drilled completed or first produced prior to 1927 that have no listed date of plugging.

The Bug Creek watershed drains portions of the Naval Petroleum Reserve and the mainstem of Bug Creek flows generally southward and crosses Quarles' western property.

The Hominy Creek watershed drains portions of the Naval Petroleum Reserve and the mainstem of Bug Creek flows generally eastward to Skiatook Lake which is adjacent to Quarles' eastern property.

The United States Geological Survey in an official publication² states that prior to the institution of Federal regulations in the 1970's produced waters³ from oil and gas production within the United States were often discharged into streams, creeks, and unlined evaporation ponds causing salt scars and surface and ground water pollution.

The United States Geological Survey in an official publication⁴ states that produced waters may be highly saline and may contain toxic metals, organic and inorganic components and radium and other naturally occurring radioactive materials (NORMs).

United States Geological Survey in an official publication⁵ found that NORMs and toxic metals were associated with oilfield wastes within Osage County, Oklahoma.

Based on a review of a database of produced water chemistry⁶ for petroleum-related wells in Osage County, Oklahoma, wells producing fluids from depths between 50 feet and 4375 feet in Osage County, Oklahoma produce water having an average total dissolved solids content of 129,693 mg/l and a median total dissolved solids content of 140,757 mg/l. For the observations reported in this database, 25% of all produced water samples had total dissolved solids contents less than 79,352 mg/l, 25% of all produced water samples had total dissolved solids contents greater than 180,990 mg/l

2 Kharaka, Y. K. and J. K. Otton. 2003. Introduction and Summary. In: Kharaka, Y. K. and J. K. Otton, editors, Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. United States Geological Survey. Water-Resources Investigations Report 03-4260.

3 Within the body of this report the terms produced water, saltwater, oilfield brine are synonymous and refer to water co-produced with petroleum.

4 Kharaka, Y. K. and J. K. Otton. 2003. Introduction and Summary. In: Kharaka, Y. K. and J. K. Otton, editors, Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. United States Geological Survey. Water-Resources Investigations Report 03-4260.

5 Otten, J. K., S. Asher-Bolinder, D.E. Owen and L. Hall. 1997. Effects of produced waters at oilfield production sites on the Osage Indian Reservation, northeastern Oklahoma. United States Geological Survey, Open File Report 97-28, 23p.

6 U. S. Geological Survey Produced Waters Database. Available at <http://energy.cr.usgs.gov/prov/prodwat/data.htm>

(data attached as Exhibit "C")

The United States Geological Survey in an official publication⁷ states with respect to extensive studies of two historic petroleum production sites near Lake Skiatook that,

"...impacts of produced water and associated hydrocarbons on soil and ground and surface waters at both sites and surrounding areas are widespread and pervasive. All wells show some degree of contamination from produced water and/or associated petroleum or its degradation products. Thus, it has been very difficult to obtain soil and water samples from "pristine" areas."

The United States Geological Survey in an official publication⁸ states that the results of their studies show that subsurface plumes of high salinity water extend from production sites to Skiatook Lake, and that from one site, "...significant amounts of produced water from the two active brine pits percolate into the surficial rocks and flow towards Skiatook Lake."

The United States Geological Survey in an official publication⁹ states that the environmental impacts of petroleum and produced water releases include salt scarring, soil salinization and oil contamination, and brine and petroleum contamination of ground water and surface water, including Skiatook Lake, a 4,250-hectare reservoir that provides drinking water to the local communities and is a major recreational fishery.

The United States Geological Survey in an official publication¹⁰ states that salt contamination from petroleum flows to Lake Skiatook both in groundwater and in surface

7 Kharaka, Y. K. and J. K. Otton. 2003. Introduction and Summary. In: Kharaka, Y. K. and J. K. Otton, editors, Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. United States Geological Survey. Water-Resources Investigations Report 03-4260.

8 Kharaka, Y. K. and J. K. Otton. 2003. Introduction and Summary. In: Kharaka, Y. K. and J. K. Otton, editors, Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. United States Geological Survey. Water-Resources Investigations Report 03-4260.

9 Kharaka, Y. K., J. J. Thordsen, E. Kakouros, and M. M. Abbott. 2003. The Fate of Inorganic and Organic Chemicals in Produced Water from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. In: Kharaka, Y. K. and J. K. Otton, editors, Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. United States Geological Survey. Water-Resources Investigations Report 03-4260.

10 Herkelrath, W. N. and Y. K. Kharaka. 2003. Hydrologic Controls on the Subsurface Transport of Oil-field Brine at the Osage-Skiatook Petroleum Environmental Research "B" Site, Oklahoma. In: Kharaka, Y. K. and J. K. Otton, editors, Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. United States Geological Survey. Water-Resources Investigations Report 03-4260.

runoff.

The United States Geological Survey in an official publication¹¹ state that at the sites studied that salt contamination is not entirely confined to areas of obvious salt scars but persists to a lesser extent over a broader area.

Review of documents received from Texaco demonstrates numerous instances of the release of saltwater to the surface and subsurface within the Naval Petroleum Reserve.¹²

The Ada-Vamoosa aquifer underlies the area of the Naval Petroleum Reserve and Quarles' western property.

Based on the work of D'Lugosz, et al. (1986)¹³, regional groundwater flow within the Ada-Vamoosa aquifer is generally west to east, but may vary locally.

The United States Geological Survey in an official publication¹⁴ notes that existing water-supply wells commonly are located in areas that produce usable volumes of potable water. Thus, the use of water-supply wells introduces a bias that tends to minimize water-quality problems, and that all samples collected from the Ada-Vamoosa aquifer were from existing domestic wells.

The United States Geological Survey in an official publications^{15,16} state that leaking surface casings, bottom-hole packers, and long strings have caused extensive pollution of near surface aquifers in Osage County, Oklahoma.

11 Zielinski, R. A., C. A. Rice, and J. K. Otton. 2003. Use of Soil Extracts to Define the Extent of Brine-impacted Soils and Bedrock at the Osage-Skiatook Petroleum Environmental Research "B" Site, Northeastern Oklahoma. In: Kharaka, Y. K. and J. K. Otton, editors, Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. United States Geological Survey. Water-Resources Investigations Report 03-4260.

12 See TX0000011 – TX003640

13 D'Lugosz, J.J., McClaflin, R.G., and Marcher, M.V., 1986, Geohydrology of the Vamoosa-Ada aquifer east-central Oklahoma: Oklahoma Geological Survey Circular 87, 42 p.

14 Abbott, M.M., 2000, Water quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma: U.S. Geological Survey Water-Resources Investigations Report 99-4231, 76 p.; Abbott, M.M., 2001, Water quality of the Quaternary and Ada-Vamoosa aquifers on the Osage Reservation, Osage County, Oklahoma, 1997. In Sublette, K.L., editor, Proceedings of the 7th International Petroleum Environmental Conference: Environmental Issues and Solutions in Petroleum Exploration, Production and Refining, Albuquerque, NM: November, 2000, Integrated Petroleum Environmental Consortium (IPEC) and the University of Tulsa.

15 Fitterman, D.V., 1985, Mapping of brine contamination in Osage County, Oklahoma, using transient electromagnetic soundings: U.S. Geological Survey Open-File Report 85-210, 57 p.

In a United States Geological Survey study of the Ada-Vamoosa Aquifer¹⁷ 99 of 120 samples reported (82.5%) contained detectable levels of bromide.

In a United States Geological Survey study of the Ada-Vamoosa Aquifer¹⁸ for those samples with detectable levels of bromide, the median Cl/Br (chloride/bromide) ratio was 220 and the mean Cl/Br ratio was 243.

In a United States Geological Survey reporting Cl/Br ratios for produced waters from Osage County, Oklahoma¹⁹, the reported range of Cl/Br ratio was 220 to 320.

In a United States Geological Survey study²⁰, the ratio of Cl/Br was used as supporting data to establish a link between salt contamination in soil and produced water.

Water produced by a water supply well located at N36.54477 W96.55618 within the Naval Petroleum Reserve was found to have total dissolved solids content of 678 mg/L,

16 Raab, P.V., and Frischknecht, F.C., 1985, Investigation of brine contamination using time-domain electromagnetic soundings: U.S. Geological Survey Open-File Report 85-528, 54 p.

17 Abbott, M.M., 2000, Water quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma: U.S. Geological Survey Water-Resources Investigations Report 99-4231, 76 p.; Abbott, M.M., 2001, Water quality of the Quaternary and Ada-Vamoosa aquifers on the Osage Reservation, Osage County, Oklahoma, 1997. In Sublette, K.L., editor, Proceedings of the 7th International Petroleum Environmental Conference: Environmental Issues and Solutions in Petroleum Exploration, Production and Refining, Albuquerque, NM: November, 2000, Integrated Petroleum Environmental Consortium (IPEC) and the University of Tulsa.

18 Abbott, M.M., 2000, Water quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma: U.S. Geological Survey Water-Resources Investigations Report 99-4231, 76 p.; Abbott, M.M., 2001, Water quality of the Quaternary and Ada-Vamoosa aquifers on the Osage Reservation, Osage County, Oklahoma, 1997. In Sublette, K.L., editor, Proceedings of the 7th International Petroleum Environmental Conference: Environmental Issues and Solutions in Petroleum Exploration, Production and Refining, Albuquerque, NM: November, 2000, Integrated Petroleum Environmental Consortium (IPEC) and the University of Tulsa.

19 Kharaka, Y. K., J. J. Thorsen, E. Kakouros, and M. M. Abbott. 2003. The Fate of Inorganic and Organic Chemicals in Produced Water from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. In: Kharaka, Y. K. and J. K. Otton, editors, Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. United States Geological Survey. Water-Resources Investigations Report 03-4260.

20 Zielinski, R. A., C. A. Rice, and J. K. Otton. 2003. Use of Soil Extracts to Define the Extent of Brine-impacted Soils and Bedrock at the Osage-Skiatook Petroleum Environmental Research "B" Site, Northeastern Oklahoma. In: Kharaka, Y. K. and J. K. Otton, editors, Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. United States Geological Survey. Water-Resources Investigations Report 03-4260.

a Cl content of 141 mg/L and a Br content of 0.894 mg/L. These results indicate that groundwater produced from this well has been impacted by produced water.

The United States Geological Survey in an official publication²¹ states that 69 percent of the outcrop area of the Ada-Vamoosa aquifer is within a quarter mile of an oil well in Osage County, Oklahoma.

The United States Geological Survey in an official publication²² states that specific conductance, dissolved solids, sodium, sulfate, chloride, bromide, and silica concentrations in samples from the Ada-Vamoosa aquifer within a quarter mile of an oil well were significantly greater than from the aquifer not near oil wells.

The United States Geological Survey in an official publication²³ states that elevated levels of specific conductance, dissolved solids, sodium, sulfate, chloride, bromide, and silica concentrations in samples from the Ada-Vamoosa aquifer within a quarter mile of an oil well are probably derived from brine water.

The United States Geological Survey in an official publication²⁴ states that 57 percent of samples from the Ada-Vamoosa aquifer within a quarter mile of an oil well have dissolved-solids concentrations greater than the secondary drinking water regulations.

21 Abbott, M.M., 2000, Water quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma: U.S. Geological Survey Water-Resources Investigations Report 99-4231, 76 p.; Abbott, M.M., 2001, Water quality of the Quaternary and Ada-Vamoosa aquifers on the Osage Reservation, Osage County, Oklahoma, 1997. In Sublette, K.L., editor, Proceedings of the 7th International Petroleum Environmental Conference: Environmental Issues and Solutions in Petroleum Exploration, Production and Refining, Albuquerque, NM: November, 2000, Integrated Petroleum Environmental Consortium (IPEC) and the University of Tulsa.

22 Abbott, M.M., 2000, Water quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma: U.S. Geological Survey Water-Resources Investigations Report 99-4231, 76 p.; Abbott, M.M., 2001, Water quality of the Quaternary and Ada-Vamoosa aquifers on the Osage Reservation, Osage County, Oklahoma, 1997. In Sublette, K.L., editor, Proceedings of the 7th International Petroleum Environmental Conference: Environmental Issues and Solutions in Petroleum Exploration, Production and Refining, Albuquerque, NM: November, 2000, Integrated Petroleum Environmental Consortium (IPEC) and the University of Tulsa.

23 Abbott, M.M., 2000, Water quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma: U.S. Geological Survey Water-Resources Investigations Report 99-4231, 76 p.; Abbott, M.M., 2001, Water quality of the Quaternary and Ada-Vamoosa aquifers on the Osage Reservation, Osage County, Oklahoma, 1997. In Sublette, K.L., editor, Proceedings of the 7th International Petroleum Environmental Conference: Environmental Issues and Solutions in Petroleum Exploration, Production and Refining, Albuquerque, NM: November, 2000, Integrated Petroleum Environmental Consortium (IPEC) and the University of Tulsa.

24 Abbott, M.M., 2000, Water quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma: U.S. Geological Survey Water-Resources Investigations Report 99-4231, 76 p.; Abbott, M.M., 2001, Water quality of the Quaternary and Ada-Vamoosa aquifers on the Osage Reservation, Osage County, Oklahoma, 1997. In Sublette, K.L., editor, Proceedings of

The United States Geological Survey in an official publication²⁵ states that areas in the Ada-Vamoosa aquifer near Hominy, Pershing, and Hula Lake have dissolved-solids concentrations greater than the secondary drinking water regulations.

The United States Department of Agriculture maps as a soil type, "Oil-waste land" within Osage County, Oklahoma (see Exhibit "D").²⁶

The following is the published description of oil-waste land presented in the United States Department of Agriculture's Soil Survey of Osage County, Oklahoma²⁷:

"44-Oil-waste land. This miscellaneous area consists of areas where oil and salt water have accumulated in pits or flowed over soils of uplands and flood plains. Individual areas are 10 to 150 acres. The slopes range from nearly level through steeply sloping.

Oil-waste land is variable in thickness to bedrock. The soil material is loamy or clayey. It has been damaged by oil and salt water to the extent that it takes in water very slowly. The erosion hazard is very severe, and very little vegetation grows on these areas.

Management is needed to leach the oil and salt from the soil where it is nearly level through very gently sloping so that vegetation can be established. Where practical, water from higher lying areas should be diverted. The application of gypsum, hay, straw, or manure and the impoundment of water where the soil is less sloping help in the reclamation of this soil material. Not assigned to a capability unit or a range site.

the 7th International Petroleum Environmental Conference: Environmental Issues and Solutions in Petroleum Exploration, Production and Refining, Albuquerque, NM: November, 2000, Integrated Petroleum Environmental Consortium (IPEC) and the University of Tulsa.

25 Abbott, M.M., 2000, Water quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma: U.S. Geological Survey Water-Resources Investigations Report 99-4231, 76 p.; Abbott, M.M., 2001, Water quality of the Quaternary and Ada-Vamoosa aquifers on the Osage Reservation, Osage County, Oklahoma, 1997. In Sublette, K.L., editor, Proceedings of the 7th International Petroleum Environmental Conference: Environmental Issues and Solutions in Petroleum Exploration, Production and Refining, Albuquerque, NM: November, 2000, Integrated Petroleum Environmental Consortium (IPEC) and the University of Tulsa.

26 Bourlier, B.G., Nichols, J.D., Ringwald, W.J., Workman, P.J., and Clemons, Stanley, 1979, Soil survey of Osage County, Oklahoma: United States Department of Agriculture, Soil Conservation Service and United States Department of the Interior, Bureau of Indian Affairs, 164 p.

27 Bourlier, B.G., Nichols, J.D., Ringwald, W.J., Workman, P.J., and Clemons, Stanley, 1979, Soil survey of Osage County, Oklahoma: United States Department of Agriculture, Soil Conservation Service and United States Department of the Interior, Bureau of Indian Affairs, 164 p.

Areas of soil mapped as "oil field wasteland" by the United States Department of Agriculture²⁸ are still visible on current aerial photographs and in the field.

Based on a review of a database provided by the Osage Nation Environmental & Natural Resources Department, numerous areas of saltwater killed vegetation and saltwater damaged land have been mapped by the Osage Nation Environmental & Natural Resources Department within Osage County, Oklahoma."

Areas mapped as oil-waste land by the United States Department of Agriculture can still be observed in current aerial photographs and in the field.

An area mapped as oil-waste land by the United States Department of Agriculture is present on Quarles' eastern property (see Exhibit "A").

An area mapped as oil-waste land by the United States Department of Agriculture is located immediately north of Quarles' western property (see Exhibit "B").

In 1961, the United States Bureau of Mines published a map and table²⁹ identifying 131 areas within Osage County where produced brine was being injected either for enhancing the recovery of petroleum or for pressure maintenance.

The United States Bureau of mines noted that water injection to aid petroleum recovery was attempted in Osage County, Oklahoma as early as 1934.³⁰

The areas identified within Osage County where produced brine was being injected either for enhancing the recovery of petroleum or for pressure maintenance include areas nearby property owned by Quarles in Osage County, Oklahoma, including specifically waterflooding and pressure maintenance projects operated by Texaco, Inc. within the Naval Reserve (24N 07E) in the vicinity of Quarles' western property and by Skelly Oil Co. within the Sundown Pool (22 and 23 N 10E) in the vicinity of Quarles' eastern property (Exhibit "E").³¹

28 Bourlier, B.G., Nichols, J.D., Ringwald, W.J., Workman, P.J., and Clemons, Stanley, 1979, Soil survey of Osage County, Oklahoma: United States Department of Agriculture, Soil Conservation Service and United States Department of the Interior, Bureau of Indian Affairs, 164 p.

29 Johnson, K.H., and Castagno, J.L., 1961, Developments in waterflooding and pressure maintenance in Osage County, Okla. oilfields, 1961: U.S. Bureau of Mines Information Circular 8038, 38 p.

30 Johnson, K.H., and Castagno, J.L., 1961, Developments in waterflooding and pressure maintenance in Osage County, Okla. oilfields, 1961: U.S. Bureau of Mines Information Circular 8038, 38 p.

31 Figure 1. – Map Showing Locations and Status of Waterflooding and Pressure-Maintenance Projects in Osage County, Okla., Dec 31, 1960 (pg. 3) and Table 1. – Summary of waterflood and pressure-maintainance operations, Osage County, Okla., July 1, 1960 (pp. 5-6) in Johnson, K.H., and Castagno,

There are numerous records of failures and leaks from injection wells in Osage County, Oklahoma.³²

Fisher and Sublette (2005)³³ reviewed complaint data available from the Oklahoma Corporation Commission (for all Oklahoma counties other than Osage County) and production data published by the Oklahoma Corporation Commission for the 10-year period 1993 through 2002.

Based on this review, Fisher and Sublette (2005)³⁴ determined that, on average, for every barrel of total liquid hydrocarbon (crude oil + condensate) produced in Oklahoma at least 0.00077779 bbls of oil and 0.00183169 bbls of saltwater are released to the environment.

Direct evidence of hydrocarbon and saltwater release from petroleum exploration and production activities is present on property in Osage County, Oklahoma owned by Quarles (see Exhibit "F").

The United States Geological Survey in an official publication³⁵ found that trash and debris from exploration and production activities is present in association with historic and/or current petroleum production sites in Osage County, Oklahoma.

Direct evidence of trash and debris from petroleum exploration and production activities is present on property in Osage County, Oklahoma owned by Quarles (see Exhibit "F").

Direct evidence of the release of oilfield wastes to waters of the United States is present on property in Osage County, Oklahoma owned by Quarles (see Exhibit "F").

Direct evidence of inadequate secondary containment around tank battery facilities is present on property in Osage County, Oklahoma owned by Quarles (see Exhibit "F").

J.L., 1961, Developments in waterflooding and pressure maintenance in Osage County, Okla. oilfields, 1961: U.S. Bureau of Mines Information Circular 8038, 38 p.

32 Osage Nation Environmental & Natural Resources Department Failures and Incidents Tables (current to February 7, 2005). Obtained from Diane Daniels, Osage Nation Environmental & Natural Resources Department, Underground Injection Control (UIC), Pawhuska, OK.

33 Fisher, J. B. and Sublette, K. L. 2005. Environmental releases from exploration and production operations in Oklahoma: Type, volume, causes, and prevention. Environmental Geosciences, 12(2): 89–99.

34 Fisher, J. B. and Sublette, K. L. in press (publication expected 2005). Environmental Releases from E&P Operations in Oklahoma: Type, Volume, Causes and Prevention. Environmental Geology.

35 Otten, J. K., S. Asher-Bolinder, D.E. Owen and L. Hall. 1997. Effects of produced waters at oilfield production sites on the Osage Indian Reservation, northeastern Oklahoma. United States Geological Survey, Open File Report 97-28, 23p.

Direct evidence of abandoned and unplugged wells is present on property in Osage County, Oklahoma owned by Quarles (see Exhibit "F").

III. Opinions

My analysis of the documents I reviewed, my training, my general work experience, and my specific work experience in the analysis of processes used in and waste streams generated by petroleum exploration and production activities, have led me to the following opinions:

Based on direct observation, production of petroleum is ongoing in Osage County, Oklahoma.

Based on review of a database of petroleum-related wells in Osage Country provided by the Osage Nation Environmental & Natural Resources Department, and based on data published by the Oklahoma Corporation Commission³⁶ oil and gas exploration and production has been a significant activity in Osage, Oklahoma County since before Oklahoma statehood in 1907.

Based on review of a database of petroleum-related wells in Osage Country provided by the Osage Nation Environmental & Natural Resources Department, oil and gas exploration and production has taken place on property owned by Quarles in Osage County, Oklahoma since 1914.

Based on direct observation and a review of historic records, historical release of petroleum and saltwater took place from petroleum production operations in Osage County, Oklahoma.

Based on direct observation and a review of historic records, historical release of petroleum and saltwater took place from petroleum production operations on property owned by Quarles in Osage County, Oklahoma

Based on direct observation, release of petroleum and saltwater is ongoing from petroleum production operations in Osage County, Oklahoma.

Based on direct observation, release of petroleum and saltwater is ongoing from petroleum production operations on property owned by Quarles in Osage County, Oklahoma.

36 Oklahoma Corporation Commission. 2004. 2003 Report on Oklahoma Oil and Natural Gas Activity Within the State of Oklahoma. Prepared by: Mr. Larry Claxton, Manager Surety and Statistical Section Technical Department Oil and Gas Conservation Division. Available at <http://www.occ.state.ok.us/Divisions/OG/AnnualReports/2004%20OIL%20AND%20GAS%20REPORT.pdf>

Sources of the historic and ongoing releases of petroleum and saltwater in Osage County, Oklahoma include, but are not limited to, leaks from wellheads, flowlines, surface equipment, including saltwater disposal pumps, tanks, inadequate secondary containment at tank batteries, saltwater disposal lines, load lines, abandoned unplugged wells, improperly plugged wells, poorly cemented casing, leaking surface casings, leaking bottom-hole packers, and leaking long strings.

Sources of the historic and ongoing releases of petroleum and saltwater on property owned by Quarles in Osage County, Oklahoma include, but are not limited to, leaks from wellheads, flowlines, surface equipment, including saltwater disposal pumps, tanks, inadequate secondary containment at tank batteries, saltwater disposal lines, load lines, abandoned unplugged wells, improperly plugged wells, poorly cemented casing, leaking surface casings, leaking bottom-hole packers, and leaking long strings.

The natural flow of surface water can move oilfield wastes, including petroleum and saltwater and naturally occurring radioactive material (NORMs) from their origin in areas on which petroleum exploration and production activities have been and/or are being conducted to areas where petroleum exploration and production activities have not been conducted.

The natural flow of surface water can move oilfield wastes, including petroleum and saltwater and naturally occurring radioactive material (NORMs) from their origin in areas on which petroleum exploration and production activities have been and/or are being conducted onto property owned by Quarles in Osage County, Oklahoma

Ongoing and historic release of petroleum and saltwater in Osage County, Oklahoma has contaminated and continues to contaminate the surface, surface water and groundwater aquifers on Quarles' property in Osage County, Oklahoma.

Oilfield wastes, including petroleum, saltwater, and possibly naturally occurring radioactive materials (NORMs) have been released and continue to be released to waters of the United States on and adjacent to property in Osage County, Oklahoma owned by Quarles from areas where petroleum exploration and production activities have been and/or are being conducted.

Oilfield wastes, including petroleum, saltwater as well as trash and debris, and possibly naturally occurring radioactive materials (NORMs) from petroleum exploration and production activities on and adjacent to property in Osage County, Oklahoma owned by Quarles, have contaminated and continue to contaminate the surface of Quarles' property in Osage County, Oklahoma in areas on which petroleum exploration and production activities have been and/or are being conducted.

Oilfield wastes, including petroleum, saltwater as well as trash and debris, and possibly naturally occurring radioactive materials (NORMs) from petroleum exploration and production activities on and adjacent to property in Osage County, Oklahoma owned by Quarles, have contaminated and continue to contaminate the surface water on Quarles' property in Osage County, Oklahoma in areas on which petroleum exploration and production activities have been and/or are being conducted.

Oilfield wastes, including petroleum, saltwater as well as trash and debris, and possibly naturally occurring radioactive materials (NORMs) from petroleum exploration and production activities on and adjacent to property in Osage County, Oklahoma owned by Quarles, have contaminated and continue to contaminate the groundwater beneath Quarles' property in Osage County, Oklahoma in areas on which petroleum exploration and production activities have been and/or are being conducted.

Oilfield wastes, including petroleum, saltwater, and possibly naturally occurring radioactive materials (NORMs) that have been released and continue to be released to waters of the United States on and adjacent to property in Osage County, Oklahoma owned by Quarles from areas where petroleum exploration and production activities have been and/or are being conducted, have contaminated, and continue to contaminate, property owned by Quarles in Osage County, Oklahoma.

Direct evidence exists of continuing and abatable point source pollution from petroleum production operations on property owned by Quarles in Osage County, Oklahoma.

The point sources of the continuing and abatable pollution on property owned by Quarles in Osage County, Oklahoma may include, but are not necessarily limited to, producing wells, service wells, temporarily abandoned wells, unplugged wells, improperly plugged wells, mud plugged wells, surface equipment, flowlines, pipelines and tanks.

Existing surface contamination resulting from releases of petroleum and produced water on property owned by Quarles in Osage County, Oklahoma constitutes a continuing threat of contamination to surface and groundwater.

Wells on property owned by Quarles in Osage County, Oklahoma for which no evidence of proper plugging exists are evidence of a continuing threat of environmental contamination.

Additional testing of soil, surface water or ground water may modify or expand these opinions.

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